THE TEHACHAPI EARTHQUAKE OF JULY 21, 1952

by G. W. Housner*

At approximately five o'clock, the morning of July 21, 1952, there occurred a strong earthquake whose center was approximately fifteen miles southwest of the small town of Tehachapi, California (population 2,500). The main shock was followed by numerous small aftershocks and several moderately strong aftershocks were experienced July 23. The main shock was rated by seismologists to have a magnitude of 7.5 on the Gutenberg-Richter magnitude scale. This compares with a magnitude of 7.1 for the Seattle, Washington shock of April 1949, a magnitude of 6.7 for the El Centro, California shock of May 1940 and 6.25 for the Long Beach, California shock of March 1933. The magnitude of an earthquake is a measure of the energy released by the shock in accordance with the following equation:

$$E = 7.4(10)^4 (10)^{1.8M}$$

where E is the total energy released by the shock in foot-pounds and M is the magnitude of the shock.

The center of the shock was located 20 miles from Tehachapi and was approximately 25 miles from the city of Bakersfield, 60 miles from the city of Santa Barbara and 75 miles from Los Angeles. The San Gabriel mountain range lies between the center of the shock and Los Angeles. A visible surface fault was reported starting five miles south of Arvin and running in a northeast direction for approximately 25 miles.

The intensity of the ground motion at Tehachapi is estimated to have been approximately the same or perhaps somewhat less than that at Long Beach, March 10, 1933. Practically all of the commercial buildings in the town were small, old and of shoddy construction and these were very severely damaged. It was reported that eleven persons were killed in Tehachapi and surrounding area by collapsing buildings. The loss of life would undoubtedly have been much greater had the shock occurred later in the day when the commercial buildings would have been occupied. The Tehachapi Lodge building, erected in 1930, a small, two-story, reinforced concrete, box-type structure, withstood the shock with only interior plaster cracking and spalling. A large steel water tank in the town, which had only light bracing not designed for earthquake forces, collapsed completely. The residences in the town, which for the most part were one-story, wood-framed structures, suffered only minor damage.

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The Women's State Prison, located approximately ten miles west of Tehachapi, is composed of a number of two-story, reinforced concrete buildings having steeply pitched tile roofs and wood roof framing. These buildings suffered moderate damage; brick chimneys toppled, gable walls cracked, window mullions and spandrel beams cracked. The buildings were designed and constructed just prior to the earthquake of March 10, 1933 and had not been specifically designed to resist earthquakes but they were relatively sturdy buildings for that type of construction.

Moderate damage was caused to some old, poorly designed buildings in the city of Bakersfield, chiefly cracking of walls and toppling of parapets. Two steel water tanks which had not been designed to resist earthquake forces collapsed. Apparently as a consequence of the earthquake there was an explosion and subsequent fire at an oil refinery. The intensity of the ground motion was approximately the same or somewhat less than in Tehachapi.

A number of buildings in the city of Santa Barbara were damaged by the earthquake. The damage was chiefly cracking of walls and in all cases the buildings were old and had not been designed and constructed to resist earthquakes. A six-story building which houses the Santa Barbara radio station suffered serious cracking in the first and third-story walls and the five-story Carillo Hotel building had serious cracking in the first-story walls. There was no collapse of building such as had occurred in Tehachapi and the intensity of the ground motion was much less in Santa Barbara than in Tehachapi.

Minor damage was reported to have occurred in a few buildings in Los Angeles, Long Beach and surrounding metropolitan area.

The ground motion was not sufficiently intense in any city to be a real test of structures which had been designed to resist earthquakes. Various non-engineering damage was reported in some of the new buildings, such as overturning of unstable filing cabinets in the upper floors, light fixtures dropping from the ceilings, etc., but the ground motion was not sufficiently severe in any metropolitan area to produce any new and significant engineering data. Photographs of some of the more interesting damage are shown in the accompanying figures. It should be noted that the buildings shown in the photographs were not designed or constructed to resist lateral forces and, consequently, damage was to be expected in the case of moderately severe ground motion.

The ground motion was recorded by strong-motion accelerometers maintained by the U. S. Coast and Geodetic Survey at Taft, Santa Barbara, Pasadena, Los Angeles and more distant stations. The accelerometer at Taft was the closest to the center of the shock, being approximately 50 miles distant. At the time of writing, the records had not yet been analyzed. The intensity of ground motion in the vicinity of the center

of the shock was appreciably less than would be expected for a shock of magnitude 7.5 . This is attributed to special geological conditions in that region and also to the fact that the faulting was chiefly vertical instead of the more usual horizontal faulting which produces more severe horizontal ground motion in the vicinity of the center of the shock.

The Tehachapi earthquake received widespread publicity through newspaper reports and radio and television broadcasts from which many persons received erroneous impressions about the severity of the shock. It is true that this earthquake was the largest to occur in California (magnitude 7.5) since the 1906 San Francisco shock (magnitude 8.2) in that it represented the largest energy release since 1906. However, for engineering purposes it is not the magnitude of an earthquake which is significant but rather the intensity of the surface ground motion. The surface intensity is greatest near the center of the shock and diminishes with increasing distance from the center. The intensity of ground motion at any particular city will depend upon the magnitude of the shock (energy released), the distance from the center of the shock, the depth of focus of shock, the type of faulting, and the geological conditions in the vicinity. Because this shock occurred in a sparsely inhabited region it is difficult to make estimates of intensities on the basis of observed building damage in the region within 20 miles of the center of the shock. However, on the basis of the small number of buildings in Tehachapi, it appeared that the ground intensity there did not exceed that experienced in the Long Beach-Compton area during the shock of March 10, 1933.

PHOTO 1

WATER TANK IN TEHACHAPI

PHOTO 2

TEHACHAPI

PHOTO 3

WATER TANK IN TEHACHAPI

PHOTO 4

REINFORCED CONCRETE BUILDING AT WOMEN'S PRISON. BRICK CHIMNEY DOWN. ONE-HALF OF CHIMNEY CAME DOWN ON THIS SIDE (NOTE 2 REINFORCING BARS). OTHER HALF WENT DOWN ON OTHER SIDE. (OTHER TWO BARS BENT OTHER WAY).

PHOTO 5

MAIN STREET IN TEHACHAPI

PHOTO 6

CARILLO HOTEL IN SANTA BARBARA. REINFORCED CONCRETE FRAME WITH BRICK FILLER WALLS. WAS ALSO DAMAGED IN SANTA BARBARA EARTHQUAKE OF 1925.

PHOTO 7

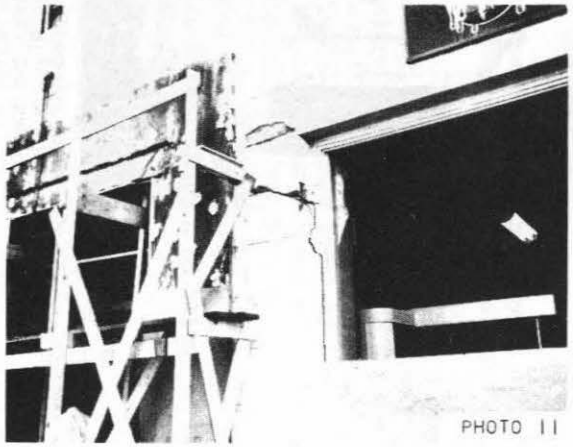
BUILDING IN TEHACHAPI

PHOTO 8

REINFORCED CONCRETE LODGE BUILDING IN TEHACHAPI. SUFFERED ONLY INTERIOR PLASTER DAMAGE. ERECTED IN 1930.

RADIO STATION BUILDING
IN SANTA BARBARA

CARRILLO HOTEL IN
SANTA BARBARA



RADIO STATION BUILDING IN SANTA BARBARA. REINFORCED CONCRETE FRAME. WAS ALSO DAMAGED IN SANTA BARBARA EARTHQUAKE OF 1925.

RADIO STATION BUILDING
IN SANTA BARBARA

PHOTO 13

RADIO STATION BUILDING
IN SANTA BARBARA

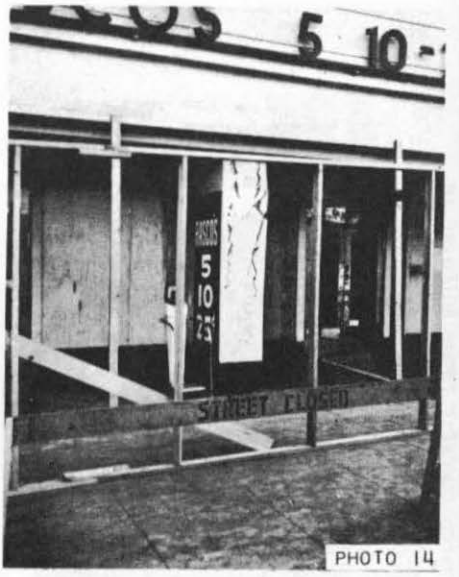


PHOTO 14

RADIO STATION BUILDING
IN SANTA BARBARA

PHOTO 15

CARRILLO HOTEL IN SANTA BARBARA SHOWING REINFORCED CONCRETE COLUMN AND CRACKING OF BRICK FILLER WALLS. SIGN BUCKLED. NOTE AMOUNT OF MOVEMENT FROM CRACK.